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Quorum polarity and the dynamics of the zooming bionematic phase

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Many species of bacteria are peritrichously flagellated, i.e. the long, helical, rapidly rotating flagella that propel them emerge out of motors that appear randomly distributed over the body of the bacterial cell. The organism considered here is *Bacillus subtilis*. The cell body is a rod approximately 4 μm long, 0.7μm in diameter; flagella are 3 or 4 times longer than the body. Swimming cells are pushed by the flagella, bundled into a braid of rotating helices. When the bacteria self concentrate into an approximately close-packed assemblage, rapidly moving (zooming) domains of aligned bacterial rods continually form and break apart. PIV measurements show that correlation times are seconds, lengths are hundreds of micrometers, transport of passive tracers is superdiffusive.Below a threshold concentration there is no collective dynamic. A theory of this zooming bionematic phase will be presented, together with measurements and video sequences. The theory considers hydrodynamic cell-cell and collective interactions, the collectively generated flow of the suspending water relative to the cells, and the dynamics of helix bundle flipping, yielding quorum polarity within a given zooming domain. Quorum sensing of signalling molecules and molecular transport generally are pertinent microbiological applications.